<u>Cognitive Speeds (psycho and create spiritual (moral stages?) and sociological "equations, Stats, similar to those of the Biological variety\\ :</u>

Average WPM: 40wpm(typing) 300wpm(reading) (characters to bits, origins of information theory values)
60min/hr*12hr/day = 28800 words per 1/2day typing or 216,000 words per ½ day reading
250-300 words per page
Under 7500 is short story
17500-39999 is a novella
40,000 words is the average novel
100,000 thriller and epic fantasies
Longest published novel at 2.5 million words "Marienbad my love, by Mark Eleach"
Harry Potter Series: 1,084,170
Lord of the rings: 455,125

<u>Life Watch</u>

1. **Response* to stimuli**: a response can take many forms, from the contraction of a unicellular organism to external chemicals, to complex reactions involving all the senses of multicellular organisms. A response is often expressed by motion; for example, the leaves of a plant turning toward the sun (phototropism), and chemotaxis.
    1. Bodies, action, reaction
    2. For every force there it's an equal and opposite
2. **Signaling / communication** is part of any communication process that governs basic activities of cells and coordinates all cell actions. The ability of cells to perceive and correctly respond to their microenvironment

- **Errors in signaling** interactions and cellular information processing are responsible for diseases such as cancer, autoimmunity, and diabetes.[1][2][3] By understanding cell signaling, diseases may be treated more effectively and, theoretically, artificial tissues may be created.[4]
    1. cellular: see 6.b.v.

4. **Adaptation**: the ability to change over time in response to the environment. This ability is fundamental to the process of evolution and is determined by the organism's heredity, diet, and external factors.

. See: learned optimism and industriousness, growth under adversity, as will add effects of trauma and the struggle to find a meaningful explanation and will to breathe.

5. **Homeostasis**: regulation of the internal environment to maintain a constant state; for example, sweating to reduce temperature

. There are **four primary vital signs** which are standard in most medical settings:

- The equipment needed is a thermometer, a sphygmomanometer, and a watch. Though a pulse can be taken by hand, a stethoscope may be required for a patient with a very weak pulse.
        1. Body temperature
- Temperature can be recorded in order to establish a baseline for the individual's normal body temperature for the site and measuring conditions. **The main reason for checking body temperature is to solicit any signs of systemic infection or inflammation in the presence of a fever (temp > 38.5 °C/101.3 °F or sustained temp > 38 °C/10.4 °F**), or elevated significantly above the individual's normal temperature.
- See: 4. b.i

ii. Heart rate or Pulse

The pulse varies with age: a newborn or infant can have a heart rate of 130–150 bpm, a toddler of 100–120 bpm, an older child of 60–100 bpm, an adolescent of 80–100 bpm, and an adult of 50–80 bpm.

iii. Respiratory rate

Varies with age, but the normal reference range for an adult is 16–20 breaths per minute.[9] the lungs contain the functional residual capacity (FRC) of air, which, in the adult human, has a volume of about 2.5–3.0 litres.[47]

- 16x2=32 liter per min / 60 sec = 0.53333 litre per sec *1.2g/l = 0.64g/ sec × 1/1000 = 0.00064kg or Newton's
- 20×3=60 lpm / " = 1 lps *"=1.2g / sec × " = 0.0012N aka 12×10^-4
- Standard atmospheric pressure = 100Kpa, 1bar or 10^5pa, or 100N
- With that as the variable range of 2-3l per b **<u>at 16bpm</u>**
    - .533 l /sec × 100kpa = 53.3 kpa
    - 1.2kg/m^3 = 1.2kpa… = 1.2N × .533 =
    - " × 1 = 1.2kg/kpa or **1.2N / m^3**
- **<u>@ 38.6 bpm</u>** (fear) × 3 l per b = 115.8 lpm or 1.93lps × 1.2N (SAP) = **2.316N / kpa**

The density of air at sea level is about **1.2 kg/m3 (1.2 g/L, 0.0012 g/cm3**). Density is not measured directly but is calculated from measurements of temperature, pressure and humidity using the equation of state for air (a form of the ideal gas law). Atmospheric density decreases as the altitude increases. This variation can be approximately modeled using the barometric formula

The average mass of the atmosphere is about 5 quadrillion (5×1015) tonnes or 1/1,200,000 the mass of Earth. According to the American National Center for Atmospheric Research, "The total mean mass of the atmosphere is 5.1480×1018 kg with an annual range due to water vapor of 1.2 or 1.5×1015 kg,

Composition

- Inhaled air is by volume 78.08% nitrogen, 20.95% oxygen and small amounts include argon, carbon dioxide, neon, helium, and hydrogen.[16
- The gas exhaled is 4% to 5% by volume of carbon dioxide, about a 100 fold increase over the inhaled amount. The volume of oxygen is reduced by a small amount, 4% to 5%, compared to the oxygen inhaled. The typical composition is:[17]
- 5.0–6.3% water vapor
- 74.4% nitrogen
- 13.6–16.0% oxygen
- 4.0–5.3% carbon dioxide
- 1% argon and several parts per million (ppm) of hydrogen and carbon monoxide, 1 ppm of ammonia and less than 1 ppm of acetone, methanol, ethanol and other volatile organic compounds.

<u>**Control**</u>

- **The rate and depth of breathing is *<u>automatically</u>* controlled by the respiratory centers that receive information from the peripheral and central chemoreceptors. These chemoreceptors continuously monitor the partial pressures of carbon dioxide and oxygen in the arterial blood. The sensors are, firstly, the central chemoreceptors on the surface of the medulla oblongata of the brain stem which are particularly sensitive to pH as well as the partial pressure of carbon dioxide in the blood and cerebrospinal fluid.[7] The second group of sensors measure the partial pressure of oxygen in the arterial blood. Together the latter are known as the peripheral chemoreceptors which are situated in the aortic and carotid bodies.[7] Information from all of these chemoreceptors is conveyed to the respiratory centers in the pons and medulla oblongata, which responds to deviations in the partial pressures of carbon dioxide and oxygen in the arterial blood from normal by adjusting the rate and depth of breathing, in such a way as to restore partial pressure of carbon dioxide back to 5.3 kPa (40 mm Hg), the pH to 7.4 and, to a lesser extent, the partial pressure of oxygen to 13 kPa (100 mm Hg).[7**

Breathing at Altitude

- Atmospheric pressure decreases with the height above sea level (altitude) and since the alveoli are open to the outside air through the open airways, the pressure in the lungs also decreases at the same rate with altitude. At altitude, a pressure differential is still required to drive air into and out of the lungs as it is at sea level. The mechanism for breathing at altitude is essentially identical to breathing at sea level but with the following differences:
- The atmospheric pressure decreases exponentially with altitude, roughly halving with every 5,500 metres (18,000 ft) rise in altitude.[19] The composition of atmospheric air is, however, almost constant below 80 km, as a result of the continuous mixing effect of the weather.[20] The concentration of oxygen in the air (mmols O_2 per liter of air) therefore decreases at the same rate as the atmospheric pressure.[20] **At sea level, where the ambient pressure is about 100 kPa, oxygen contributes 21% of the atmosphere and the partial pressure of oxygen (PO_2) is 21 kPa (i.e. 21% of 100 kPa). At the summit of Mount Everest, 8,848 metres (29,029 ft), where the total atmospheric pressure is 33.7 kPa, oxygen still contributes 21% of the atmosphere but its partial pressure is only 7.1 kPa (i.e. 21% of 33.7 kPa = 7.1 kPa).**[20] Therefore, a greater volume of air must be inhaled at altitude than at sea level in order to breath in the same amount of oxygen in a given period.
- The pressure gradient forcing air into the lungs during inhalation is also reduced by altitude. Doubling the volume of the lungs halves the pressure in the lungs at any altitude. Halving the sea level air pressure (100 kPa) results in a pressure gradient of 50 kPa but doing the same at 5500 m, where the atmospheric pressure is 50 kPa, a doubling of the volume of the lungs results in a pressure gradient of only 25 kPa. In practice, because **we breathe in a gentle, cyclical manner that generates pressure gradients of only 2–3 kPa**, this has little effect on the actual rate of inflow into the lungs and is easily compensated for by breathing slightly deeper.[22][23]
- See : 6.b.(arterial blood gas ratio/ ph / blood pressure

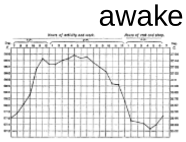
iv. Blood pressure

- elevated blood pressure (hypertension) is variously defined when the systolic number is persistently over 140–160 mmHg. Low blood pressure is hypotension.

b. Controls of [human] variables

1. **Core temperature** / Thermoregulation is the ability of an organism to keep its body temperature within certain boundaries, even when the surrounding temperature is very different

- **The normal human body temperature range** is typically stated as **36.5–37.5 °C (97.7–99.5 °F)**.[8]
- **Natural rhythms :** Body temperature normally fluctuates over the day following Circadian rhythms, with the lowest levels around 4 a.m. and the highest in the late afternoon, between 4:00 and 6:00 p.m. (assuming the person sleeps at night and stays awake during the day).[10]

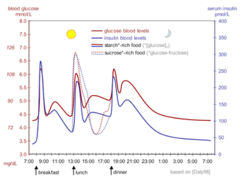


ii. Blood glucose

- The blood sugar level, blood sugar concentration, or blood glucose level is the amount of glucose present in the blood of humans and other animals. Glucose is a simple sugar and approximately 4 grams of glucose are present in the blood of a 70-kilogram (150 lb) human at all times.[2]
- The body's homeostatic mechanism of blood sugar regulation (known as glucose homeostasis), when operating normally, restores the blood sugar level to a narrow range

of about **4.4 to 6.1 mmol/L (79 to 110 mg/dL)** (as measured by a fasting blood glucose test).[6]

- The body tightly regulates blood glucose levels as a part of metabolic homeostasis.[2] Glucose is stored in skeletal muscle and liver cells in the form of glycogen;[2] in fasted individuals, blood glucose is maintained at a constant level at the expense of glycogen stores in the liver and skeletal muscle.[2]
- In humans, glucose is the primary source of energy, and is critical for normal function, in a number of tissues,[2] particularly the human brain which consumes approximately 60% of blood glucose in fasted, sedentary individuals.[2]
- Hormones that influence blood glucose levels:



iii. Plasma/ Blood pH

- The plasma pH can be altered by respiratory changes in the partial pressure of carbon dioxide; or altered by metabolic changes in the carbonic acid to bicarbonate ion ratio. The bicarbonate buffer system regulates the ratio of carbonic acid to bicarbonate to be equal to 1:20, at which ratio the blood pH is 7.4 (as explained in the Henderson–Hasselbalch equation). A change in the plasma pH gives an acid–base imbalance. In acid–base homeostasis there are two mechanisms that can help regulate the pH. Respiratory compensation a mechanism of the respiratory center, adjusts the partial pressure of carbon dioxide by changing the rate and depth of breathing, to bring the pH back to normal. The partial pressure of carbon dioxide also determines the concentration of carbonic acid, and the bicarbonate buffer system can also come into play. Renal compensation can help the bicarbonate buffer system

iv. Levels of blood gases

- Changes in the levels of oxygen, carbon dioxide and plasma pH are sent to the respiratory center, in the brainstem where they are regulated. The partial pressure of oxygen and carbon dioxide in the arterial blood is monitored by the peripheral chemoreceptors (PNS) in the carotid artery and aortic arch. A change in the partial pressure of carbon dioxide is detected as altered pH in the cerebrospinal fluid by central chemoreceptors (CNS) in the medulla oblongata of the brainstem. Information from these sets of sensors is sent to the respiratory center which activates the effector organs – the diaphragm and other muscles of respiration. An increased level of carbon dioxide in the blood, or a decreased level of oxygen, will result in a deeper breathing pattern and increased respiratory rate to bring the blood gases back to equilibrium.
- Too little carbon dioxide, and, to a lesser extent, too much oxygen in the blood can temporarily halt breathing, a condition known as apnea, which freedivers use to prolong the time they can stay underwater.
- **Blood gas tension** refers to the partial pressure of gases in blood.[1] There are several significant purposes for measuring gas tension;[2] the most common gas tensions measured are oxygen tension[3] (PxO2), the carbon dioxide tension[3] (PxCO2) and carbon monoxide tension[3] (PxCO).

Oxygen tension

- PaO2 – **Partial pressure of oxygen at sea level** (765 mmHg) **in arterial blood** is between 75 mmHg and 100 mmHg.[4][5][6]
- PvO2 – **Oxygen tension in venous blood at sea level is between 30 mmHg and 40 mmHg**.[6][7]

Carbon dioxide tension : Carbon dioxide is a by-product of food metabolism and in high amounts has toxic effects including: dyspnea, acidosis and altered consciousness.[8]

- PaCO2 – **Partial pressure of carbon dioxide at sea level (765 mmHg) in arterial blood is between 35 mmHg and 45 mmHg**.[9]
- PvCO2 – **Partial pressure of carbon dioxide at sea level in venous blood is between 40 mmHg and 50 mmHg.[9]**

Carbon monoxide tension

- PaCO – **Partial pressure of CO at sea level (765 mmHg) in arterial blood is approximately 0.02.** It can be slightly higher in smokers and people living in dense urban areas.

v. Arterial blood pressure

- Normal resting blood pressure in an adult is approximately 120 millimetres of mercury (16 kPa) systolic, and 80 millimetres of mercury (11 kPa) diastolic, abbreviated "**120/80 mmHg**".

vi. Iron levels

Importance of iron regulation:

1. **Cellular respiration**
2. **Oxygen transport**
3. **Toxicity**
4. **bacterial protection**

- **Iron-deficiency anemia affected about 1.48 billion people in 2015**.[6] A lack of dietary iron is estimated to cause approximately half of all anemia cases globally.[12] Women and young children are most commonly affected.[3] **In 2015 anemia due to iron deficiency resulted in about 54,000 deaths –** down from 213,000 deaths in 1990.[7][13]

vii. Copper regulation

- Copper is an essential trace element that is vital to the health of all living things (humans, plants, animals, and microorganisms). In humans, copper is essential to the proper functioning of organs and metabolic processes. The human body has complex homeostatic mechanisms which attempt to ensure a constant supply of available copper, while eliminating excess copper whenever this occurs. However, like all essential elements and nutrients, too much or too little nutritional ingestion of copper can result in a corresponding condition of copper excess or deficiency in the body, each of which has its own unique set of adverse health effects.
- The World Health Organization recommends a minimal acceptable intake of approximately **1.3 mg/day**.[44]

viii. Calcium levels

- Calcium is the most abundant mineral in the human body. **The average adult body contains in total approximately 1 kg, 99% in the skeleton in the form of calcium phosphate salts** . The **extracellular fluid (ECF) contains approximately 22 mmol, of which about 9 mmol is in the plasma**.[3] Approximately **10 mmol of calcium is exchanged between bone and the ECF over a period of twenty-four hours**.[4] The **concentration of calcium ions inside the cells (in the intracellular fluid) is more than 7,000 times lower than in the blood plasma** (i.e. at **<0.0002 mmol/L**, compared with 1.4 mmol/L in the plasma)
- The normal adult diet contains about 25 mmol of calcium per day. Only about 5 mmol of this is absorbed into the body per day (see below).[12]

ix. Sodium concentration

- The minimum physiological **requirement for sodium is between 115 and 500 milligrams per day** depending on sweating due to physical activity, and whether the person is adapted to the climate.[8] Sodium chloride is the principal source of sodium in

the diet, and is used as seasoning and preservative, such as for pickling and jerky; most of it comes from processed foods.[9] **The Adequate Intake for sodium is 1.2 to 1.5 grams per day**,[10] but *on average people in the United States consume 3.4 grams per day*,[7][11] the minimum amount that promotes hypertension.[12] (Note that salt contains about 39.3% sodium by mass[13]—the rest being chlorine and other trace chemicals; thus the UL of 2.3g sodium would be about 5.9g of salt—about 1 teaspoon[14])

- **Normal serum sodium levels** are between approximately **135 and 145 mEq/liter (135 - 145 mmol/L).** A serum sodium level of less than 135 mEq/L qualifies as hyponatremia, which is considered severe when the serum sodium level is below 125 mEq/L.[15][16]

x. Potassium concentration

- Potassium levels influence multiple physiological processes, including[53][54][55]

1. **resting cellular-membrane potential and the propagation of action potentials in neuronal, muscular, and cardiac tissue**.

- Due to the electrostatic and chemical properties, K+ions are larger than Na+ions, and ion channels and pumps in cell membranes can differentiate between the two ions, actively pumping or passively passing one of the two ions while blocking the other.[56]

2. **hormone secretion and action**
3. **vascular tone**
4. **systemic blood pressure control**
5. **gastrointestinal motility**
6. **acid–base homeostasis**
7. **glucose and insulin metabolism**
8. **mineralocorticoid action**
9. **renal concentrating ability**
10. **fluid and electrolyte balance**

- **Plasma potassium is normally kept at 3.5 to 5.0 millimoles (mmol)** [or milliequivalents (mEq)] per liter by multiple mechanisms. *Levels outside this range are associated with an increasing rate of death from multiple causes,[57] and some cardiac, kidney,[58] and lung diseases progress more rapidly* if serum potassium levels are not maintained within the normal range.
- An average meal of 40-50 mmol presents the body with more potassium than is present in all plasma (20-25 mmol). However, this surge causes the plasma potassium to rise only 10% at most as a result of prompt and efficient clearance by both renal and extra-renal mechanisms.[59]
-

xi. Fluid balance / Osmoregulation and Thirst

- In a large study of adults of all ages and both sexes, **the adult human body averaged ~65% water.**
- A constant supply is needed to replenish the fluids lost through normal physiological activities, such as respiration, perspiration and urination. **Food contributes 0.5 to 1 l/day,** and the metabolism of **protein, fat, and carbohydrates produces another 0.25 to 0.4 l/day**,[6] which means that **2 to 3 l/day of water for men and 1 to 2 l/day of water for women should be consumed** as fluid to meet the Recommended Daily Intake (RDI).
- **Fluid balance** is an aspect of the homeostasis of organisms in which the amount of water in the organism needs to be controlled, via osmoregulation and behavior, such that the concentrations of electrolytes (salts in solution) in the various body fluids are kept within healthy ranges. The core principle of fluid balance is that the amount of water lost from the body must equal the amount of water taken in; for example, in humans, the output (via respiration, perspiration, urination, defecation, and expectoration) must equal

the input (via eating and drinking, or by parenteral intake). **Euvolemia** is the state of normal body fluid volume, including blood volume, interstitial fluid volume, and intracellular fluid volume; hypovolemia and hypervolemia are imbalances. **Water is necessary for all life on Earth. Humans can survive for 4 to 6 weeks without food but only for a few days without water.**

- **Intracellular fluid** (2/3 of body water) is fluid contained within cells. In a 72-kg body containing 40 litres of fluid, about 25 litres is intracellular,[7] which amounts to 62.5%. Jackson's texts states 70% of body fluid is intracellular.[8]
- **Extracellular fluid** (1/3 of body water) is fluid contained in areas outside of cells. For a 40-litre body, about 15 litres is extracellular,[7] which amounts to 37.5%.
- **Plasma** (1/5 of extracellular fluid). Of this 15 litres of extracellular fluid, plasma volume averages 3 litres,[7] or 20%.
- **Interstitial fluid** (4/5 of extracellular fluid)
- **Transcellular fluid** (a.k.a. "third space," normally ignored in calculations) contained inside organs, such as the gastrointestinal, cerebrospinal, peritoneal, and ocular fluids.
- In humans, total body water can be estimated based on the premorbid (or ideal) body weight and correction factor

TB = Weight*C

- C is a coefficient for the expected percentage of weight made up of free water. For adult, non-elderly males, C = 0.6. For adult elderly males, malnourished males, or females, C = 0.5. For adult elderly or malnourished females C = 0.45. A total body water deficit (TBWD) can then be approximated by the following formula:

TBD = TBW *(1- [Na]t/[Na]m)

- Where [Na]t = target sodium concentration (usually 140 mEq/L), and [Na]m = measured sodium concentration.
- The resultant value is the approximate volume of free water required to correct a hypernatremic state.
- The total amount of water in the body needs to be kept in balance. Fluid balance involves keeping the fluid volume stabilised, and also keeping the levels of electrolytes in the extracellular fluid stable. Fluid balance is maintained by the process of osmoregulation and by behaviour. Osmotic pressure is detected by osmoreceptors in the median preoptic nucleus in the hypothalamus. Measurement of the plasma osmolality to give an indication of the water content of the body, relies on the fact that water losses from the body, (through unavoidable water loss through the skin which is not entirely waterproof and therefore always slightly moist, water vapor in the exhaled air, sweating, vomiting, normal feces and especially diarrhea) are all hypotonic, meaning that they are less salty than the body fluids (compare, for instance, the taste of saliva with that of tears. The latter have almost the same salt content as the extracellular fluid, whereas the former is hypotonic with respect to plasma. Saliva does not taste salty, whereas tears are decidedly salty). Nearly all normal and abnormal losses of body water therefore cause the extracellular fluid to become hypertonic. Conversely excessive fluid intake dilutes the extracellular fluid causing the hypothalamus to register hypotonic hyponatremia conditions.

Trace Elements

- There are a variety of trace elements present in virtually all potable water, some of which play a role in metabolism. For example, sodium, potassium and chloride are common chemicals found in small amounts in most waters, and these elements play a role in body metabolism. Other elements such as fluoride, while arguably beneficial in low concentrations, can cause dental problems and other issues when present at high levels. Water is essential for the growth and maintenance of our bodies, as it is involved in a number of biological processes.

xii. **Cerebrospinal fluid**

- Cerebrospinal fluid (CSF) allows for regulation of the distribution of substances between cells of the brain,[59] and neuroendocrine factors, to which slight changes can cause problems or damage to the nervous system. For example, high glycine concentration disrupts temperature and blood pressure control, and high CSF pH causes dizziness and syncope.[60]

xiii. **Neurotransmission** : Inhibitory neurons in the central nervous system play a homeostatic role in the balance of neuronal activity between excitation and inhibition. Inhibitory neurons using GABA, make compensating changes in the neuronal networks preventing runaway levels of excitation.[61] An imbalance between excitation and inhibition is seen to be implicated in a number of neuropsychiatric disorders.[62]

xiv. **Neuroendocrine system**

- The neuroendocrine system is the mechanism by which the hypothalamus maintains homeostasis, regulating metabolism, reproduction, eating and drinking behaviour, energy utilization, osmolarity and blood pressure.
- The regulation of metabolism, is carried out by hypothalamic interconnections to other glands.[63] Three endocrine glands of the hypothalamic –pituitary– gonadal axis (HPG axis) often work together and have important regulatory functions. Two other regulatory endocrine axes are the hypothalamic–pituitary–adrenal axis (HPA axis) and the hypothalamic– pituitary–thyroid axis (HPT axis).
    1. See :

xv. **Gene regulation**

xvi. **Energy balance**

- The amount of energy taken in through nutrition needs to match the amount of energy used. To achieve energy homeostasis appetite is regulated by two hormones, grehlin and leptin. Grehlin stimulates hunger and the intake of food and leptin acts to signal satiety (fullness).

5. **Growth**: maintenance of a higher rate of anabolism than catabolism. A growing organism increases in size in all of its parts, rather than simply accumulating matter.
6. **Organization**: being structurally composed of one or more cells – the basic units of life

a. Organism 10 main organs

i.Animal cell (eukaryotic) 10 main organs

1. Membrane
2. Nucleus
3. Smooth reticulum
4. Rough reticulum
5. Cytoplasm
6. golgi apparatus
7. Cytoskeleton

b. Human:

10 Systems and 80 organs

1. **Musculo-skeletal system**

See also: List of bones of the human skeleton and List of muscles of the human body

1. Human skeleton
2. Joints
3. Ligaments
4. Muscular system
5. Tendons

ii. **Respiratory system**

1. Nasal cavity
2. Pharynx
3. Larynx
4. Trachea
5. Bronchi
6. Lungs
7. Diaphragm

iii. **Digestive system**

1. Mouth
2. Teeth
3. Tongue
4. Salivary glands
5. Parotid glands
6. Submandibular glands
7. Sublingual glands
8. Pharynx
9. Esophagus
10. Stomach
11. Small intestine
12. Duodenum
13. Jejunum
14. Ileum
15. Large intestine
16. Liver
17. Gallbladder
18. Mesentery
19. Pancreas
20. Anal canal and anus
21. Appendix

iv. **Excretory/ Renal/ Urinary system**

1. Kidneys
2. Ureters
3. Bladder
4. Urethra

v. **Endocrine system**

1. Pituitary gland
2. Pineal gland
3. Thyroid gland
4. Parathyroid glands
5. Adrenal glands
6. Pancreas

- **Cell signaling** is part of any communication process that governs basic activities of cells and coordinates all cell actions. The ability of cells to perceive and correctly respond to their microenvironment is the basis of development, tissue repair, and immunity, as well as normal tissue homeostasis. Errors in signaling interactions and cellular information processing are responsible for diseases such as cancer, autoimmunity, and diabetes.[1][2][3] By understanding cell signaling, diseases may be treated more effectively and, theoretically, artificial tissues may be created.[4]
- Cell signaling can be classified to be mechanical and biochemical based on the type of the signal. Mechanical signals are the forces exerted on the cell and the forces produced by the cell. These forces can both be sensed and responded by the cells.[11]

Biochemical signals are the biochemical molecules such as proteins, lipids, ions and gases. These signals can be categorized based on the distance between signaling and responder cells. Signaling within, between, and amongst cells is subdivided into the following classifications:

- **Intracrine signals** are produced by the target cell that stay within the target cell.
- **Autocrine signals** are produced by the target cell, are secreted, and affect the target cell itself via receptors. Sometimes autocrine cells can target cells close by if they are the same type of cell as the emitting cell. An example of this are immune cells.
- **Juxtacrine signals** target adjacent (touching) cells. These signals are transmitted along cell membranes via protein or lipid components integral to the membrane and are capable of affecting either the emitting cell or cells immediately adjacent.
- **Paracrine signals** target cells in the vicinity of the emitting cell. Neurotransmitters represent an example.
- **Endocrine signals** target distant cells. Endocrine cells produce hormones that travel through the blood to reach all parts of the body.
- Cells communicate with each other via direct contact (juxtacrine signaling), over short distances (paracrine signaling), or over large distances and/or scales (endocrine signaling).
- Some cell–cell communication requires direct cell–cell contact. Some cells can form gap junctions that connect their cytoplasm to the cytoplasm of adjacent cells. In cardiac muscle, gap junctions between adjacent cells allows for action potential propagation from the cardiac pacemaker region of the heart to spread and coordinately cause contraction of the heart.

vi. **Circulatory system**

See also: List of arteries of the human body and List of veins of the human body

1. Heart
2. Patent Foramen Ovale
3. Arteries
4. Veins
5. Capillaries

vii. **Lymphatic / Immune system**

1. Lymphatic vessel
2. Lymph node
3. Bone marrow
4. Thymus
5. Spleen
6. Gut-associated lymphoid tissue
7. Tonsils

viii. **Nervous system**

1. Brain
2. Cerebrum
3. Cerebral hemispheres
4. Diencephalon
5. The brainstem
6. Midbrain
7. Pons
8. Medulla oblongata
9. Cerebellum
10. The spinal cord
11. The ventricular system

12. Choroid plexus

Peripheral nervous system

See also: List of nerves of the human body

13. Nerves
14. Cranial nerves
15. Spinal nerves
16. Ganglia
13. Enteric nervous system

Sensory organs

18. Eye
19. Cornea
20. Iris
21. Ciliary body
22. Lens
23. Retina
24. Ear
25. Outer ear
26. Earlobe
27. Eardrum
28. Middle ear
29. Ossicles
30. Inner ear
31. Cochlea
32. Vestibule of the ear
33. Semicircular canals
34. Olfactory epithelium
35. Tongue
36. Taste buds

ix. **Reproductive system**

Female

Internal reproductive organs

1. Ovaries
2. Fallopian tubes
3. Uterus
4. Vagina

External reproductive organs:

5. Vulva
6. Clitoris
7. Placenta

Male reproductive system

Internal reproductive organs

8. Testes
9. Epididymis
10. Vas deferens
11. Seminal vesicles
12. Prostate
13. Bulbourethral glands

External reproductive organs

14. Penis
15. Scrotum

x. Integumentary system

0. Mammary glands
1. Skin
2. Subcutaneous tissue

xi. 112 totaled organs

0. Male: (-7 Female organs) 105
1. Female: (-8 Male organs) 104

8. **Metabolism**: transformation of energy by converting chemicals and energy into cellular components (anabolism) and decomposing organic matter (catabolism). Living things require energy to maintain internal organization (homeostasis) and to produce the other phenomena associated with life.

See: 5.b.iii.1-21. & 5.b.iv.1-4.

9. **Reproduction**: the ability to produce new individual organisms, either asexually from a single parent organism or sexually from two parent organisms.

. See: 5.b.ix.1-15